Version With Markings To Show Changes Made

5. (Five Times Amended) A recuperative heat exchanger for the exchange of heat across a plurality of heat transferring planar elements between a first fluid medium and a second fluid medium, said fluid mediums flowing in opposite directions to each other on opposite sides of said planar elements, said heat exchanger comprising:

a casing for containing a heat transfer package therein, said casing having a top end, a bottom end, a pair of respective lengthwise and widthwise opposed sides, each of said lengthwise sides provided with a pair of inlet and outlet ports, wherein each respective pair of inlet and outlet ports is dedicated to one of said first and second mediums for flow therethrough;

a heat transfer package disposed within said casing, said heat exchange package having a lengthwise extent and a widthwise extent, each of the fluid mediums following on their respective side of the planar elements a net flow path which extends longitudinally along the lengthwise extent, said package comprised of a plurality of generally rectangularly shaped planar elements continuously arranged in sequentially alternating directions in a folded accordion-like manner, each of said planar elements having substantially similar length, width and thickness with respect to each other, each of said planar elements integrally connected to an adjacent planar element along said length, said length and width of said casing substantially corresponding to said length and width of said package, opposing surfaces from each adjacent planar element defining an inter-layer space therebetween for receiving a flow of one of said fluid mediums therebetween, a direction of flow of each medium having a widthwise element and a lengthwise element when flowing within said inter-layer space, each of said planar elements having a corrugated pattern formed therein, said corrugated pattern extending the entire length and width of each respective planar element, said pattern corresponding to a series of alternating ridges and channels extending across the width of each respective planar element formed at an angle of more than 45 degrees with respect to said length of said planar elements, which pattern, in respect to the net flow path, are oriented in a more transverse than lengthwise direction, said corrugated pattern interrupted at substantially similar intervals to include a fold line for facilitating arranging each of said planar elements in an accordion-like manner, said fold lines defining said width of each respective element and being disposed parallel along said length of each of said elements, wherein when said heat transfer package is in an unfolded

state, a pattern of ridges and channels of a first planar element is generally aligned with respect to a pattern of channels and ridges of a successive planar element, and

wherein when said heat transfer package is in a folded state, said pattern on every other planar element is co-extensive to the other and said ridges and channels between facing sides of adjacent planar elements form a crossing pattern to each other such that said crossing pattern creates a flow resistance to said respective fluid medium flowing over said respective side of said planar element [such that a resistance to flow of each fluid medium is great in said lengthwise direction of said heat transfer package than said widthwise direction], the ridges and channels being arranged at an angle greater than 45 degrees with respect to a line arranged in a direction along the lengthwise extent so as to present a flow resistance greater in the lengthwise extent direction than the widthwise extent direction, the angle of the ridges and channels tending to increase the overall pressure drop across the heat exchanger compared to smaller angle configurations and force the fluid medium to travel more readily in the widthwise directions before exiting the heat exchanger, the angle of the ridges and channels arranged to force the fluid medium to exhibit a substantially thermally balanced flow distribution across the widthwise extent of the heat exchanger surfaces, thereby increasing flow turbulence and heat transfer.

Remarks

The Examiner rejects claims 5 and 7 - 11 under 35 USC §103 (a) in view of *ACV* (Su 800500) and *Hultgren*.

Regarding *ACV*, applicant has obtained an English translation of the reference, a copy of which is enclosed for the Examiner's ready reference. This reference is directed to a nozzle made from paper impregnated with thermoplastic resin. Partial polycondensation of the resin is carried out, a solvent moistens the bending lines, and then complete polycondensation of the resin is carried out. This reference addresses special problems associated with bending paper into a heat exchanger shape, and does not even discuss the angles of the corrugations. Its utter silence on this point cannot be taken as a teaching of the presently claimed flow path arrangement.

Regarding *Hultgren*, as was earlier pointed out, this reference clearly teaches away from a configuration which tends to increase turbulence and the overall pressure drop across the lengthwise extent of the device. This is admitted by the Examiner in bold letters at the top of page 4 of his Official Action. It is well known that increased turbulence increases heat transfer efficiency. It is also well known that this increased efficiency generally comes at the price of increased energy to move the fluid through the exchanger. *Hultgren* goes to great lengths to repeatedly state that its configuration is arranged to avoid turbulence and increased pressure drop. See *Hultgren*, column 1 lines 41 - 43. This reference teaches a heat exchanger which achieves its desired objects while keeping the angles less than 20 degrees, preferably about 5 degrees. It is teaching a certain "circulation effect" which is a balance of the various well known fluid mechanics and heat transfer principles while struggling to keep flow in the laminar range because of the reference's aversion for increased pressure drop. To take the reference as a teaching that increased angles above 45 degrees would be desirable is simply to misread the reference. The logic which would allow *Hultgren* to be taken to teach the desirability of increased longitudinal pressure drop in order to achieve better widthwise thermal flow balance, despite it's urgings against this approach, would allow any reference which mentions pressure drop and heat transfer efficiency to teach any and all heat transfer structures. The Examiner here has stepped well past the disclosure of *Hultgren*, which actually teaches against the structure and effect of the presently claimed invention, to state essentially that because the principles of heat transfer efficiency vs. pressure drop are well known, the presently claimed invention is obvious. However, he has yet to produce a reference or combination of references which

has a structure which spreads the flow purposely in a widthwise direction at the expense of some overall pressure drop, to achieve the goal of balanced thermal flow.

The present invention teaches that, given the relevant principles of fluid mechanics and thermodynamics, the specified and presently claimed structure results in a new device through a new combination of those principles.

Specifically, the balanced flow distribution is now recited in the amended claims. These claims now more clearly distinguish the present invention from *Hultgren* and *ACV*. Applicant therefore respectfully requests that in view of these new claims, and the foregoing remarks, the presently claimed invention is allowable over the cited art. Applicant therefore asserts that all of the objections have been obviated, and respectfully requests withdrawal of those objections and allowance of the Application.

REQUEST FOR EXTENSION OF THE TERM

Applicant respectfully requests an extension of the normal term which expired on September 4, 2002, for 3 months, to November 27, 2002.

Submitted herewith is a check for $920 to cover the cost of the extension.

Any deficiency or overpayment should be charged or credited to Deposit Account Number 04-2219, referencing our Docket Number 5098.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on November 27, 2002.

Erin Barry